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PATENT SPECIFICATION

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(72) Inventor MERVYN BARTRAM

(54) IMPROVEMENTS IN AND REALATING TO TELESCOPIC HYDRAULIC SHOCK ABSORBERS

(71) We, ARMSTRONG PATENTS CO. LIMITED, a British Company, of Bucklersbury House, Bucklersbury, London, E.C.4., do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention concerns telescopic hydraulic shock absorbers of the type comprising an inner or pressure tube arranged coaxially within an outer tube, the two tubes co-operating to define between them an annular space constituting a hydraulic reservoir, a piston working in the pressure tube, valved damping means in the piston and further valve means between at least one pair of adjacent ends of the two tubes for controlling hydraulic fluid flow between the reservoir and the interior of the pressure tube.

Telescopic hydraulic shock absorbers of the type described above are in widespread use and normally have damping characteristics such that the damping imparted to piston movement by the aforementioned valve means remains sensibly constant over substantially the whole extent through which it is possible for the piston to move in the pressure tube in accordance with the steady load to which the shock absorber is subjected; in other words, the damping imparted to the piston remains constant regardless of the mean position which the piston adopts in the pressure cylinder.

The invention seeks to provide a telescopic shock absorber in which lesser damping is available in the unladen state of the shock absorber and in which higher damping is applied to the piston under laden conditions.

According to the present invention, a telescopic shock absorber of the type described includes a fluid by-pass which provides communication between the high pressure side and the low pressure side of the piston only when the shock absorber is subjected to a predetermined minimum load whereby a leak path is parallel with the valved damping means in the piston is provided between the high pressure side and the low pressure side of the piston only when the piston is in its minimum load position.

In this way as the piston oscillates about its mean position in the unladen condition of the shock absorber, there is available to the hydraulic fluid, a leak path from the high pressure side of the piston to the low pressure side, the leak path being in parallel with the valved damping means in the piston. However, when the shock absorber is subjected to a normal, heavier load, the piston adopts a mean position in the pressure tube remote from the fluid by-pass due to contraction of the shock absorber, the leak path is rendered inoperative and the damping determined by the valved damping means in the piston becomes effective.

The fluid by-pass may take the form of one or more axially directed local deformations such as grooves in the pressure tube wall, or alternatively the pressure tube may be bulged at the appropriate region to give it an internal diameter, around a part of its periphery, slightly greater than that which it has elsewhere. Yet again, the by-pass may be provided by forming one or more pairs of axially spaced ports in the pressure tube and connecting such ports by means of suitable conduits located in the hydraulic reservoir to provide a fluid flow path from one side of the piston to the other.

The invention will be described further, by way of example, with reference to the drawing accompanying the Provisional Specification which is a diagrammatic axial section of a telescopic hydraulic shock absorber embodying the invention.

In the shock absorber illustrated in the drawing, a pressure tube 10 is arranged coaxially within an outer tube 12, the annular space 14 between the two tubes serving as a reservoir for hydraulic fluid. Within the pressure tube 10 is arranged a piston 16 carried at the inner end of a piston rod 18 which extends out of the pressure tube to terminate in a bolt eye 20 intended for securing to part

of a vehicle structure. At the end through which the piston rod 18 passes, the two tubes 10 and 12 are closed and located relative to one another by a piston rod bearing 22 in which is incorporated a fluid seal 24. The opposite ends of the tubes are closed and mutually located by a plug member 26 extending axially from an end closure disc 28 in turn carrying a second bolt eye 30.

The piston 16 and piston rod 18 are formed with an axial bore 32 communicating with radial ports 34 and, internally of the piston 16, the bore 32 opens into a valve seat 36 which is normally closed by a spring-loaded valve member 38. A valve controlled fluid flow passage is thus established from one side of the piston to the other by way of further ports 40 formed in the front face of the piston 16. At its rear face the piston 16 is formed with ports 42 which open into an annular groove 44 provided in the rear face of the piston 16, the groove 44 being normally closed by a spring-loaded plate valve member 46. The valve controlled ports 42 thus constitute a second fluid flow path through the piston 16, but in the reverse direction to that previously described.

The plug member 26 has a hollow interior which communicates by way of radial ports 48 with the reservoir 14 and through an axial bore 50 with the pressure tube space in front of the piston 16. The bore 50 is normally closed by a spring biased valve member 52 and is circumscribed by an annular groove 54 into which open ports 56 formed in the inner end face of the plug member 26. The groove 54 is normally closed by a spring-loaded plate valve member 58.

In the piston 16 and the plug member 26, the valves including the valve members 38 and 52 act as damping valves, the valve member 38 acting to damp outward or rebound movements of the piston 16 whilst the valve member 52 damps inward or load-induced piston movements, the spring settings of the two valve members 38 and 52 determining the degree of damping to which the piston 16 is subjected in the two directions. The valves including the plate valve members 46 and 58 are essentially recuperation valves which permit a relatively free flow of fluid from one side to the other of the piston and the plug member respectively in one direction of piston movement but prevent such flow in the other direction.

It will be appreciated that, when a shock absorber such as that described above is mounted in a vehicle suspension, the piston 16 will oscillate about different mean positions according to the extent to which the vehicle is laden, and by way of example, the drawing indicates a position I which the piston occupies in the unladen condition and a position II which it occupies when laden. In any mean position which it adopts, the piston 16 will oscillate about this position between limits, diagrammatically indicated at I*a*, I*b* and II*a*, II*b*, and it is desirable in many vehicle suspensions that a lesser degree of damping shall be applied to the piston in position I than in the laden position II. For this purpose, over the axial distance between the limits I*a* and I*b*, the pressure tube 10 is outwardly locally deformed to define a groove 60 which constitutes a fluid by-pass around the piston 16 and which thus modifies the damping imparted to piston motion by the damping valves. The degree to which the normal damping is reduced is governed by the radial depth of the groove 60. If desired, more than one groove 60 may be formed in the pressure tube at the unladen piston position I or the tube 10 may be bulged around a part of its periphery. Alternatively, in place of the groove 60, the pressure tube may be formed with axially spaced ports connected by a conduit located in the reservoir space 14.

WHAT WE CLAIM IS:—

1. A telescopic hydraulic shock absorber comprising an inner or pressure tube arranged coaxially within an outer tube, the two tubes cooperating to define between them an annular space which constitutes a hydraulic reservoir, a piston working in the pressure tube, valved damping means in the piston, further valve means between at least one pair of adjacent ends of the two tubes to control hydraulic fluid flow between the reservoir and the interior of the pressure tube, and a fluid bypass which provides communication between the high pressure side and the low pressure side of the piston only when the shock absorber is subjected to a predetermined minimum load whereby a leak path is parallel with the valved damping means in the piston is provided between the high pressure side and the low pressure side of the piston only when the piston is in its minimum load position.

2. A shock absorber as claimed in claim 1 in which the by-pass comprises at least one local deformation in the wall of the pressure tube.

3. A shock absorber as claimed in claim 1 or claim 2 in which the by-pass comprises at least one axially directed groove formed in the wall of the pressure tube.

4. A shock absorber as claimed in claim 1 or claim 2 in which the by-pass comprises at least one outwardly projecting and axially directed bulge formed in the wall of the pressure tube.

5. A shock absorber as claimed in claim 1 or claim 2 in which the by-pass is constituted by an increased diameter portion of the pressure tube.

6. A shock absorber as claimed in claim 1 or claim 2 in which the by-pass comprises at least one pair of axially spaced ports in the

pressure tube, the ports of each pair being interconnected by a conduit located in the hydraulic reservoir.

7. A telescopic hydraulic shock absorber constructed and adapted to operate substantially as hereinbefore described with reference to and as illustrated in the drawing accompanying the Provisional Specification.

W. P. THOMPSON & CO.,
Seaton Buildings,
Paragon Square,
Hull.
and
12, Church Street,
Liverpool, 1.
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1238508 PROVISIONAL SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*